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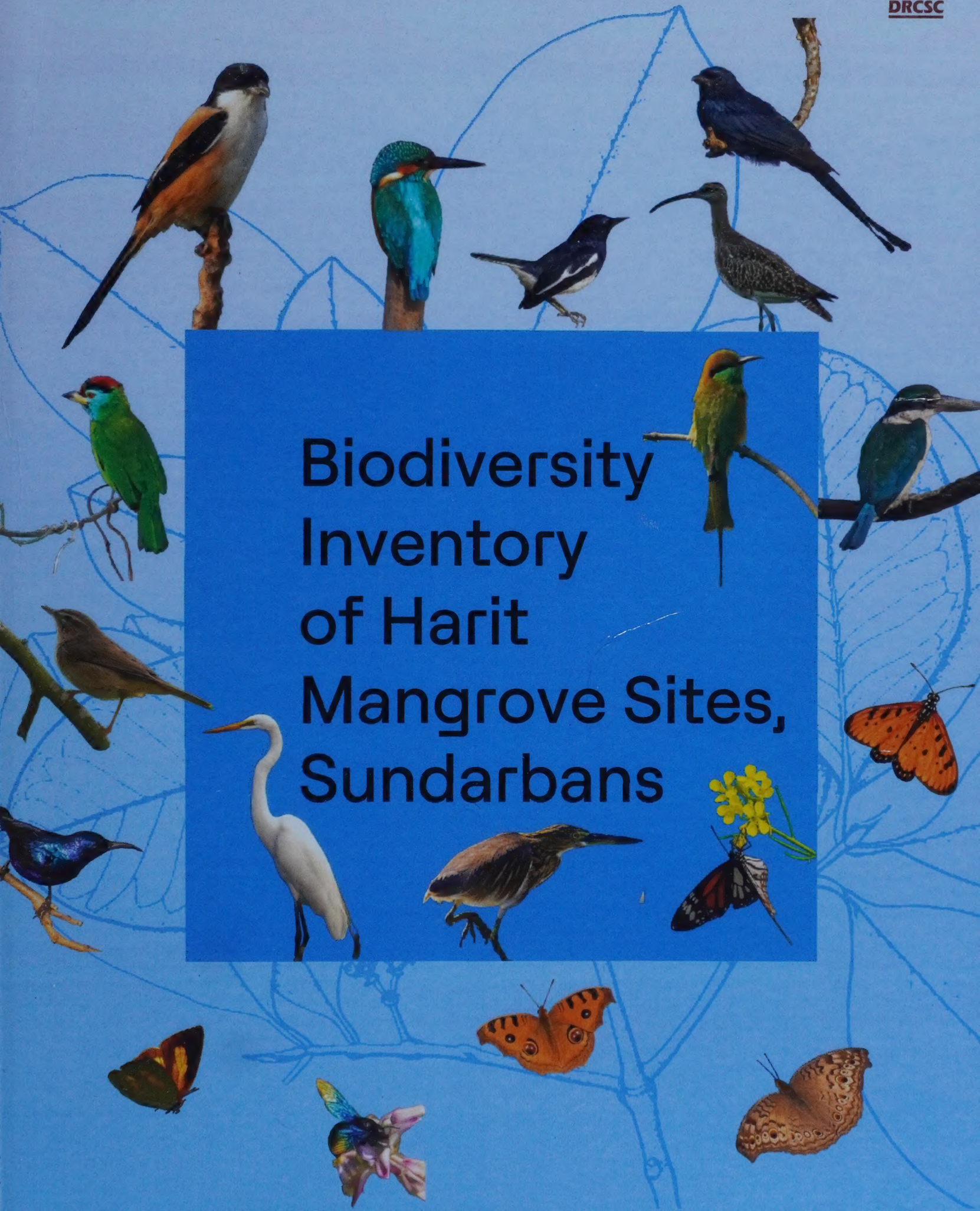

Biodiversity Inventory of Harit Mangrove Sites, Sundarbans

Biodiversity Inventory of Harit Mangrove Sites, Sundarbans

Restoration and Rehabilitation of Mangrove and Social Forestry Ecosystem in the Coastal Sundarbans.

Implemented by
Development Research Communication and Services Centre (DRCSC)

CSR Partner
HCLFoundation

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Introduction

Biodiversity is important to most aspects of our lives. It is being valued both for what it provides for humans, and for the value it has. The term biodiversity refers to the variety of life on the planet at each level, from genes to ecosystems, and can cover the evolutionary, ecological, and cultural processes that can sustain life.

Biodiversity not only includes species that we consider rare, threatened, or endangered but also every living organism.

Biodiversity includes not only the world's species with their unique evolutionary histories, but also genetic variability within and among populations of species and the distribution of species across local habitats, ecosystems, landscapes, and whole continents or oceans.

There is genetic diversity within species. If each species were reduced to one small population of genetically similar individuals, we would lose much biodiversity. As we move across a region, the species change, even if the numbers of species in different places might not, a forest and an adjacent grassland might contain almost entirely different assemblages of species, for instance. Moreover, the ecosystem processes in a grassland differ from those in the forest nearby.

The genetic variability among individuals within a species can result from gene recombination or mutation, genetic polymorphism (the presence of different forms of the same gene), isolation of gene pools, local selection pressures, habitat (environmental) complexity, landscape mosaics, and environmental gradients. Specific genetic combinations in populations result from natural selection acting on individuals in response to biotic and abiotic environments and from random, nonselective fixation of genes.

Why Is Biodiversity Important?

Biodiversity is valuable for many reasons, some utilitarian, some fundamental. Utilitarian values cover many basic issues humans gain from biodiversity such as food, shelter, fuel, and medicine. Further, ecosystems provide vital services such as pollination, seed dispersal, climate regulation, nutrient circulation, water purification, and control of agricultural pests. Biodiversity also holds value for potential benefits not yet recognized, such as new medicines and other possible unknown services. Biodiversity encompasses cultural value to humans as well. These relational values are part of peoples' individual or collective sense of wellbeing, responsibility for, and connection with the environment. The different values placed on biodiversity are important because they can influence the conservation decisions people make every day.

Marine and Coastal Biodiversity

The ocean is one of the main repositories of the world's biodiversity. It constitutes over 90 per cent of the habitable space on the planet and contains some 250,000 known species, with many more remaining to be discoveredat least two thirds of the world's marine species are still unidentified (1). The life therein, are critical to the healthy functioning of the planet, supplying half of the oxygen we breathe (2) and absorbing annually about 26 per cent of the anthropogenic carbon dioxide emitted into the atmosphere (3).

Evidence continues to emerge demonstrating the essential role of marine biodiversity in underpinning a healthy planet and social well-being. Marine ecosystems provide innumerable services for coastal communities around the world. For example, mangrove ecosystems are an important source of food for more than 210 million people (4) but they also deliver a range of other services, such as livelihoods, clean water, forest products, and protection against erosion and extreme weather events. These are amongst the most productive marine ecosystems on Earth, providing a unique habitat opportunity for many species and key goods and services for human beings. Mangrove habitats are regressing at an alarming rate, due to direct anthropogenic impacts and global change (5).

Challenges to Biodiversity

Over the last decades, the dominance of humans has caused rapid ecosystem changes and resulted in massive loss of biodiversity across the planet.

This has led some people to refer to the time we now live in as the "anthropocene." While the Earth has always experienced changes and extinctions, today they are occurring at an unprecedented rate. Major direct threats to biodiversity include habitat loss and fragmentation, unsustainable resource use, invasive species, pollution, and global climate change. The underlying causes of biodiversity loss, such as a growing human population and over consumption are often complex and stem from many interrelated factors.

But as humans put increasing pressure on the planet, using and consuming more resources than ever before, we risk upsetting the balance of ecosystems and losing biodiversity.

Since 1970, 69% decline in global population of mammals, fish, birds, reptiles, and amphibians was reported by WWF (Living Planet Report, 2022).

The 2019 landmark Global Assessment Report by the Intergovernmental Platform on Biodiversity and Ecosystem Services reported 1 million animal and plant species are now threatened with extinction the highest number in human history.

Three-quarters of the land-based environment and roughly 66% of the ocean environment have been significantly altered. More than a third of the world's land surface and nearly 75% of freshwater resources are now devoted to crop or livestock production. Climate change worsens the impact of other stressors on nature and our well-being. Humans have overfished the oceans, cleared forests, polluted our water sources, and created a climate crisis. These actions are impacting biodiversity around the world, from the most remote locales to our own backyards.

Our Interventions

Under the project "Restoration and Rehabilitation of Mangrove and Social Forestry Ecosystem in the Coastal Sundarbans", supported by HCL Foundation, DRCSC have been planted more than 5,25,000 mangrove saplings of different species covering almost 58 hectares area in 10 village panchayats of Hingalganj and Patharpratima blocks. 30 Mangrove Protection Groups are formed with local community women of the project areas aiming at the plantation, conservation and restoration of mangroves. Every Mangrove Protection Groups are consisting of almost 10 to 15 women of local villages. In a spell of two years total 39 sites were covered under mangrove plantation. The planted mangroves species are Kankra (*Bruguiera gymnorhiza*), Baine *(Avicennia officinalis*), Goran (*Ceriops decandra*), Garjan (*Rhizophora apiculata*), Sundari (*Heritiera fomes*), Golpata (*Nypa fruticans*), etc.

Biodiversity workshop at Hingalganj

Biodiversity workshop at Patharpratima

Biodiversity workshops were carried out with HCL Foundation, expert team, a team of DRCSC and community participants at Hingalganj and Patharpratima. The topic was discussed in detail regarding biodiversity, conservation and related challenges.

To prepare a biodiversity register/ Inventory (avian, butterfly and honeybee) of the Harit mangrove sites areas.

To understand the assemblages and diversity of different faunal species especially the birds, butterflies and honey bees.

1. Harit restored Mangrove site

Among Harit mangrove restoration sites in West Bengal, two sites of different administrative blocks were selected, named Hingalganj and Patharpratima.

Twelve sites from eleven villages are chosen from three gram panchayats in each block in total 6 gram panchayats for the documentation of biodiversity. The studied sites are on the banks of river Goureshwar, Kalindi and Sahebkhali in Hingalganj and Mridangavanga, Kakmara, Saptamukhi in Patharpratima. The Ichhamati-Raimangal Plain, one of the district's three physiographic areas located in the lower Ganges Delta, includes Hingalganj Block. It comprises soil ranging from mature black to brownish loam to recent alluvium. The Ichhamati river flows through the district's eastern portion as per District Survey Report, 2018.

Hingalganj Block covers an area of 238.80 km^2. Patharpratima is situated in the southern part of South 24 Parganas district which is separated into two different physiographic zones: the marine-riverine delta to the north and the marine

Mangrove plantation & conservation at Kumarpur site

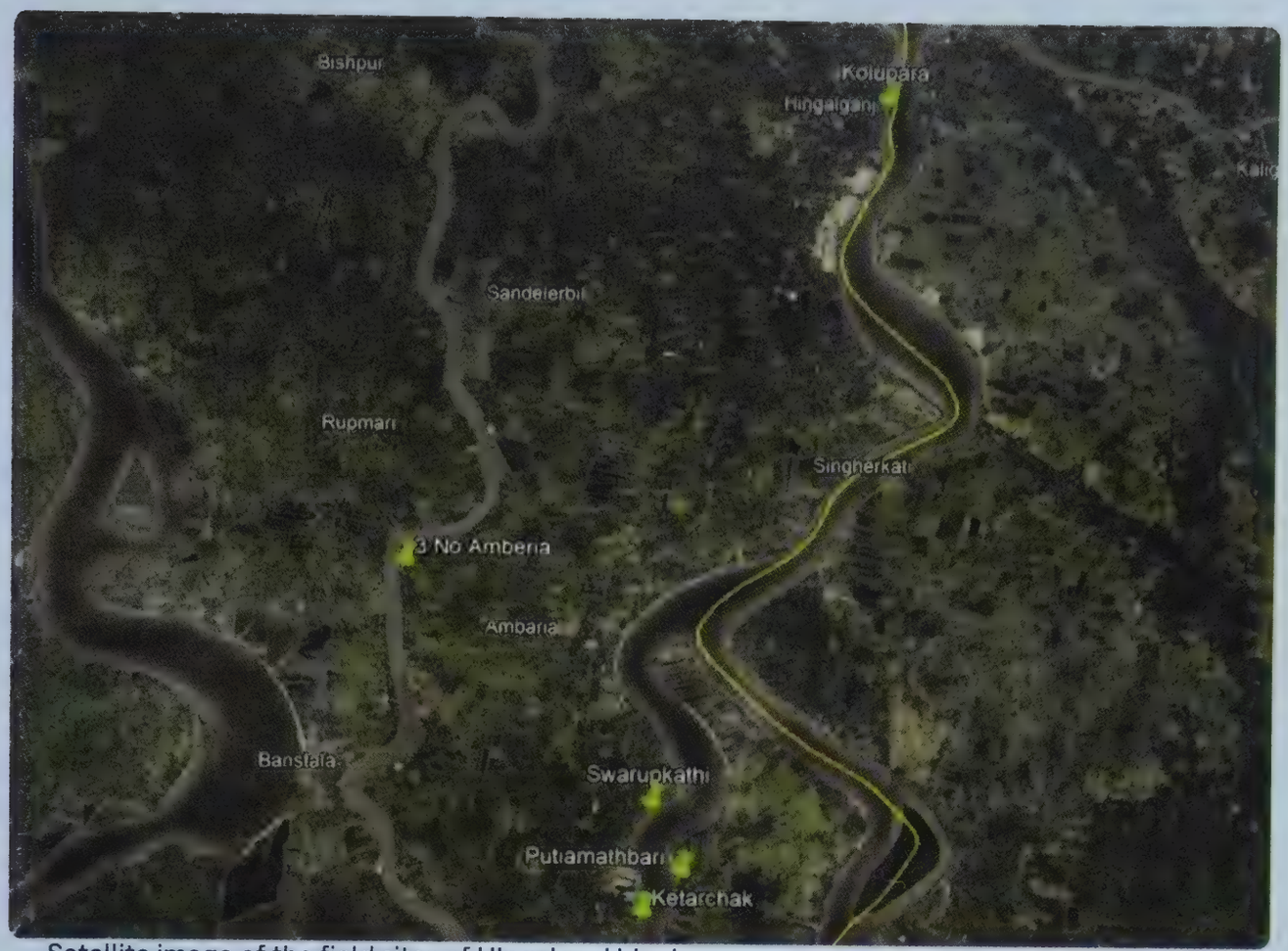
delta zone to the south. As the water withdrew southward in the recent geological era, a massive low-lying plain was exposed. Both tidal inflows and rivers have deposited silt in this plain. The recurrent collapse of both natural levees and man-made embankments accelerates the process of filling in depressions harbouring brackish water wetlands. The marine delta in the south is made up of interlacing tidal channels. Agriculture is dominated by the monsoon season due to a scarcity of non-saline irrigation water. Some areas of the wetlands are being used to raise fish. Patharpratima block covers 484.47 km^2. Patharpratima block has 241.9 km of embankments, the 2nd highest among the 12 Sundarbans blocks as per government records.

Both of the blocks are adjacent to the Sundarbans. The Sundarbans Reserve Forest (SRF), located in the south-west of Bangladesh between the river Baleswar in the East and the Harinbanga in the West, adjoining to the Bay of Bengal, is the largest contiguous mangrove forest in the world. Lying between latitude 21° 27' 30" and 22° 30' 00" North and longitude 89° 02' 00" and 90° 00' 00" East and with a total area of 10,000 km^2, 60% of the property lies in Bangladesh and the rest in India. The land area, including exposed sandbars, occupies 414,259 ha (70%) with water bodies covering 187,413 ha (30%).

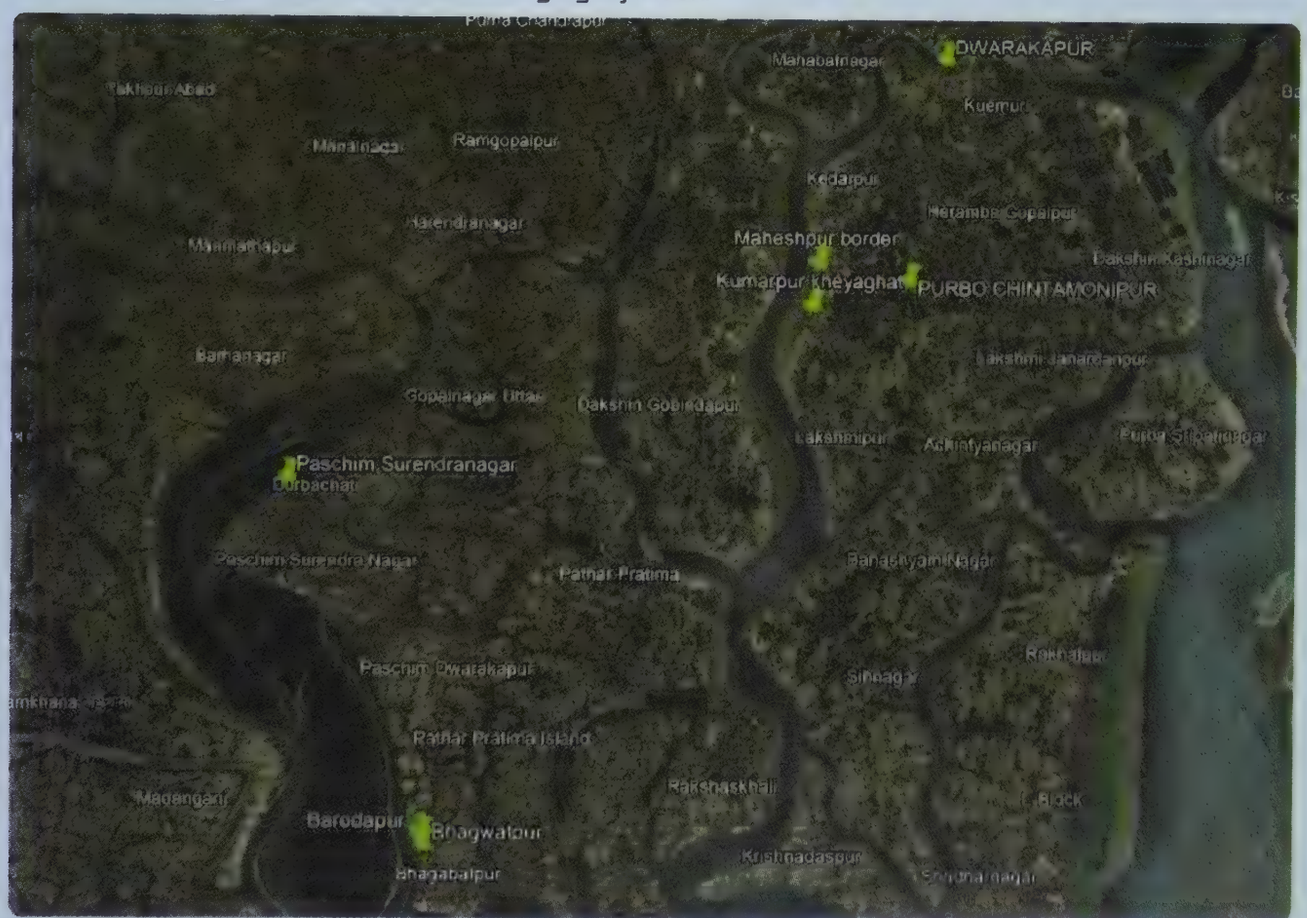
The area is vulnerable to natural disasters such as cyclones, thunderstorms, hail, and floods. There are almost 63,400 km of embankments, however floods induced by high tides frequently wash away much of the embankments, which have already been undermined and shattered by previous cyclonic storms. thus, restoring mangrove habitat is critical for both human settlements and the environment.

Field sites included in the Inventory are given in the table below.

Sr. no.	Hingalganj	Geo Co-ordinates (in degree decimal)	Patharpratima	Geo Co-ordinates (in degree decimal)
1	3 no amberia	22.416596, 88.940694	Kumarpur	21.845548, 88.399891
2	Putiamathbari	22.385228, 88.968768	Dwarakapur	21.899284, 88.432983
3	Swarupkathi	22.392006, 88.96591	Puraba chintamanipur	21.850276, 88.422188
4	Ketarchak	22.381495, 88.964583	Baradapur	21.73781, 88.309606
5	Kolupara	22.46019, 88.993469	Bhagbatpur	21.735625, 88.310164
6	Bankra dobar	22.418178, 88.982388,	Durbachhati	21.812907, 88.280181



Satellite image of the field sites of HIngalganj block.



Satellite image of the field sites of Patharpratima block.

Birds

2. Our approach

To assess the recent status and availability of birds, butterflies and bees at the Restored Harit Mangrove sites at Sundarban, there are several scientific practices and methods that can be used based on situations. The methods are mentioned below.

2.1. Sampling

For Avifauna (birds)

- Point count: Point-count monitoring (Figure) is a common way to monitor bird populations. It is characterized by tallying all birds observed at a fixed location during specific, repeated observation periods. It provides the relative abundance of all bird species and over time, can detect trends in the abundance with a relatively small amount of work compared to other methods (CJ Ralph,1995).
- To observe the diversity and abundance of birds in the project area we used point count method. We selected a random point in the site and studied for 15 minutes by scanning the 360° around the point with an approximate radius of 50 meters. Birds were identified up to species level using and documented using pictorial field guides such as Ali (2002) and Grimmett et al. (2016). All observed species were photographed using a hand-held Digital Camera (canon 7D mark ii with 100-400mm lens and canon 70D with 55-250mm lens). We studied eight random points (8 replication) in each village. In total, we sampled 96 points in 12 villages throughout the duration.

Illustration of point count method

For Butterflies

- Transect walk: Line transect sampling involves an observer travelling along a designated line of given length recording the number of individuals from target taxa, and other relevant objects (e.g. puddling, mating) detected (Buckland et al. 2001; Gibbons & Gregory 2006). Line transects are very adaptable, and are suited to surveys of terrestrial, aquatic and marine environments. The method is suitable for various taxa, including butterflies that are highly mobile and conspicuous, occur in low density populations, have patchy distributions (provided sampling is adequate), or inhabit extensive, homogeneous, open habitats (such as grasslands, oceans, and open water, etc.).

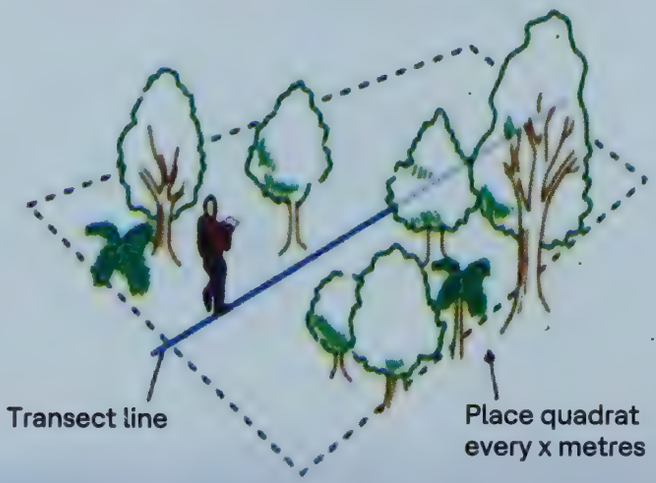
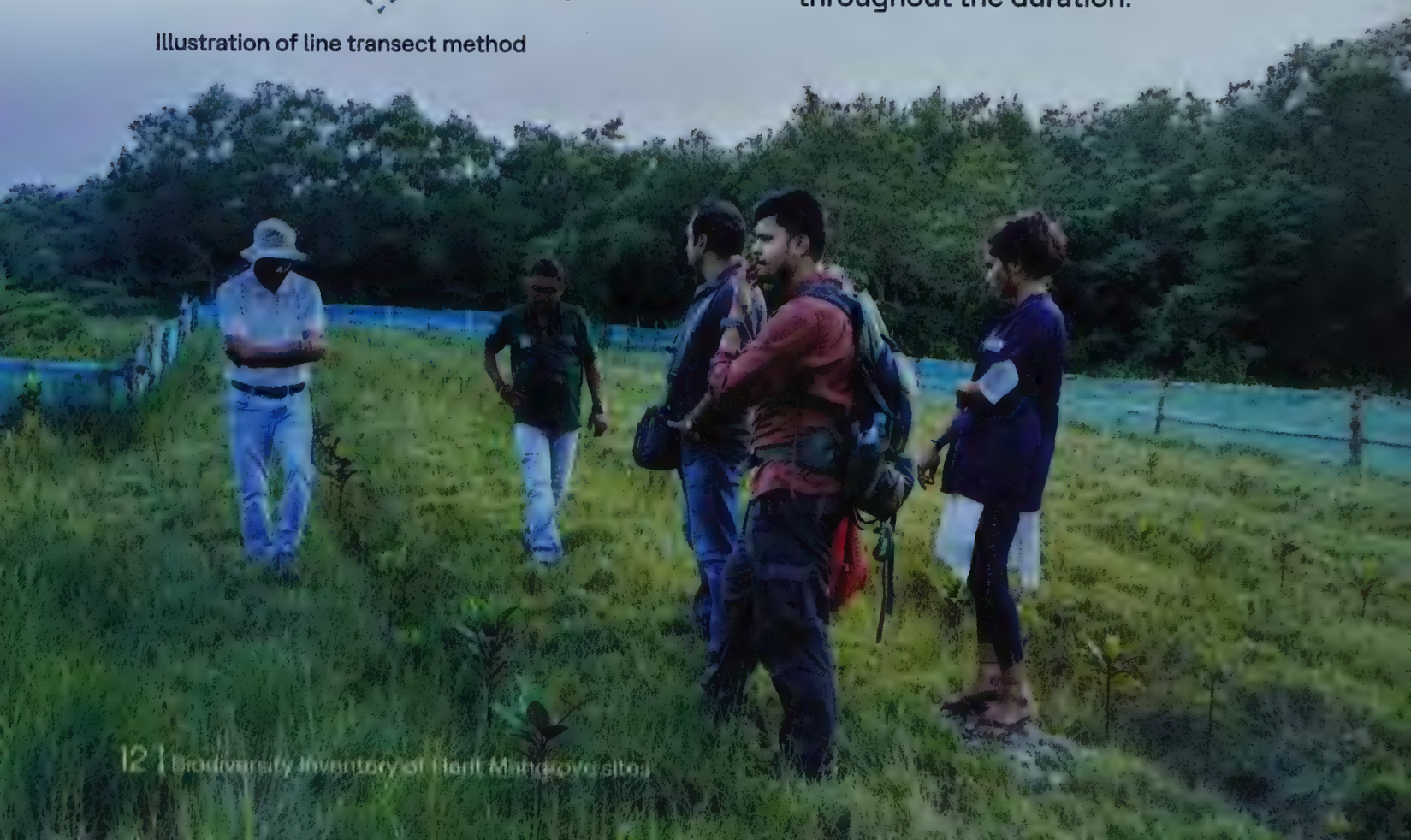


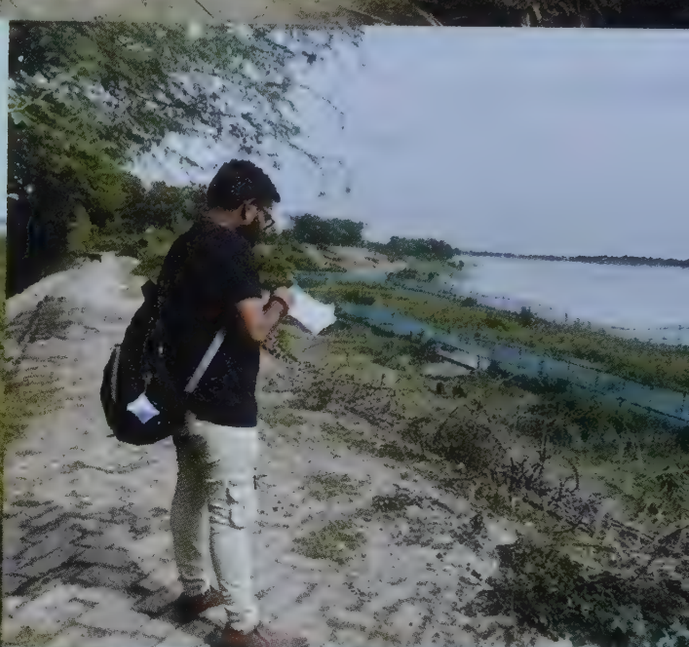
Illustration of line transect method

Honeybee sampling

- An opportunistic survey was done to record the bees' presence in the site. Honeybees were identified using available resources in person and through online sources.
- To observe the abundance and diversity of butterflies, we have used the transect walk method. A random 10 meter transects were traversed in each village. Transect walks were repeated 8 times throughout the sampling duration. Butterflies were identified by using a field guide (Butterflies of India: BNHS Field Guide by Isaac Kehimkar 2008). All observed species were photographed using hand-held Digital Cameras. In total, we sampled 96 points in 12 villages throughout the duration.



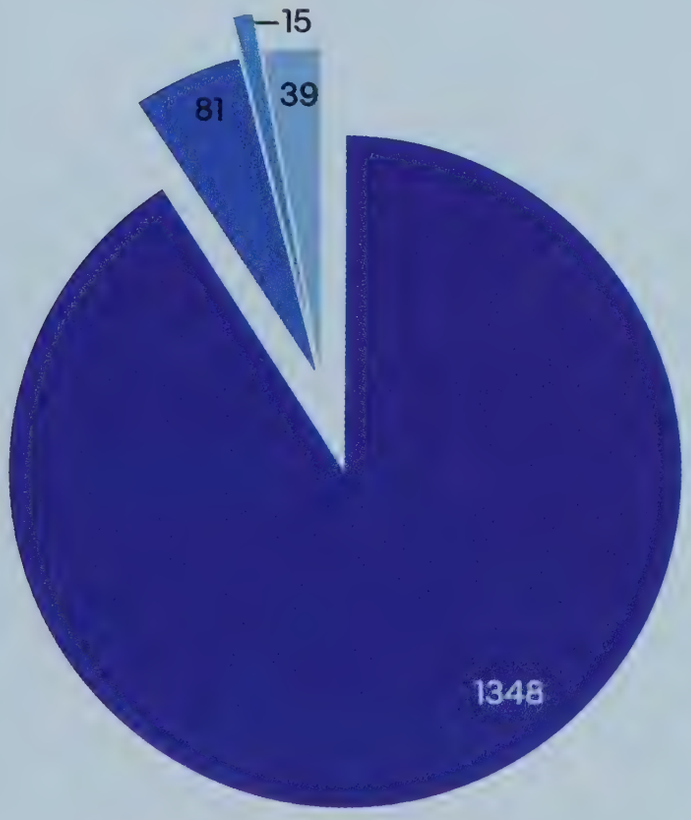
eam while collecting the field data



3. Major Findings

For Avifauna (birds)

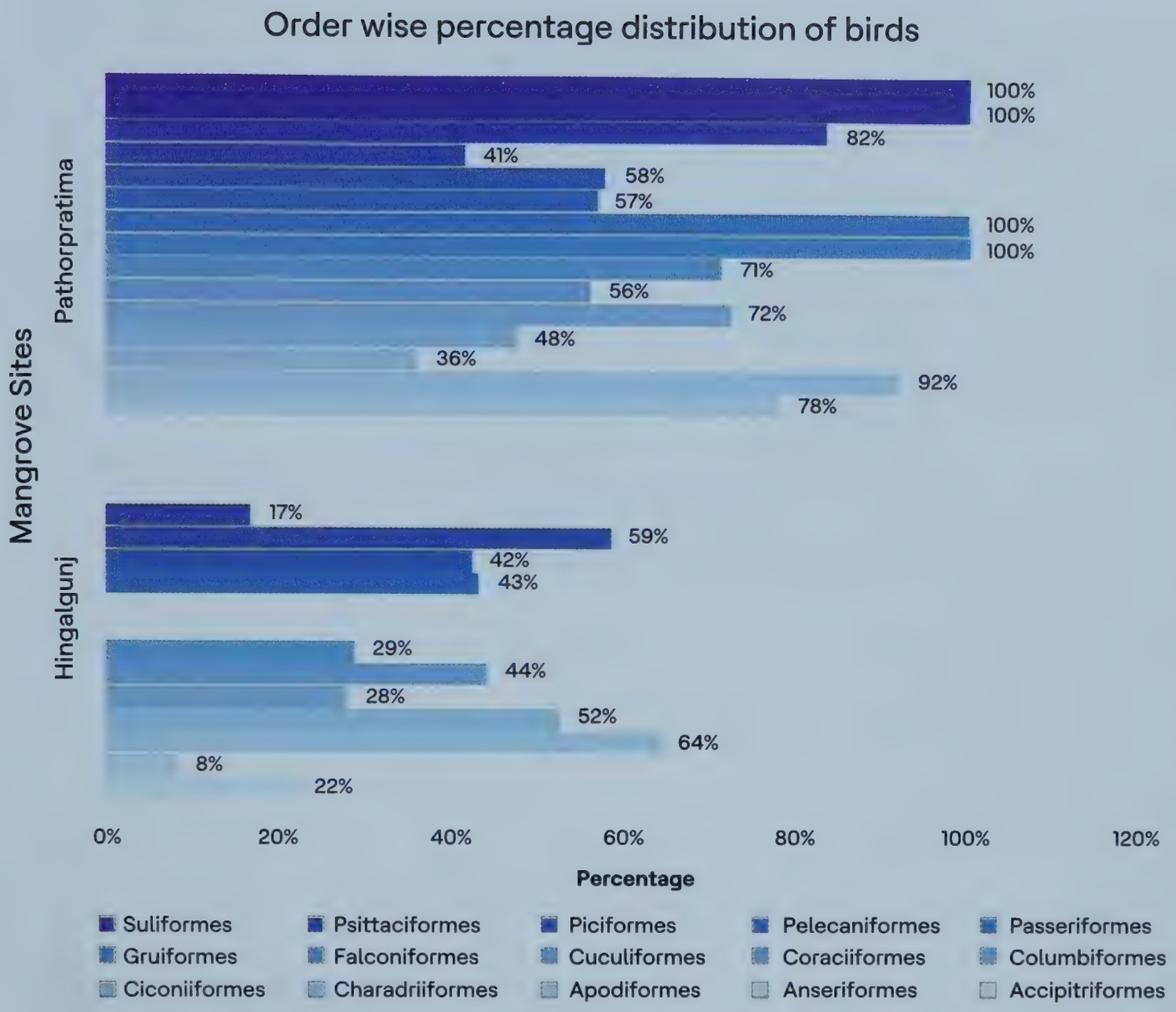
A total of 1,348 individuals of 81 species from 15 orders and 39 families of birds were recorded during our survey (Table 1). 60 species of birds were found in Hingalganj sites such as Asian palm swift, Spotted dove, House sparrow, Common myna, Purple sunbird, Gadwall, Common sandpiper, Plain prinia, Green bee eater, Black drongo, Jungle crow, etc.



Representation of bird records (taxonomic)

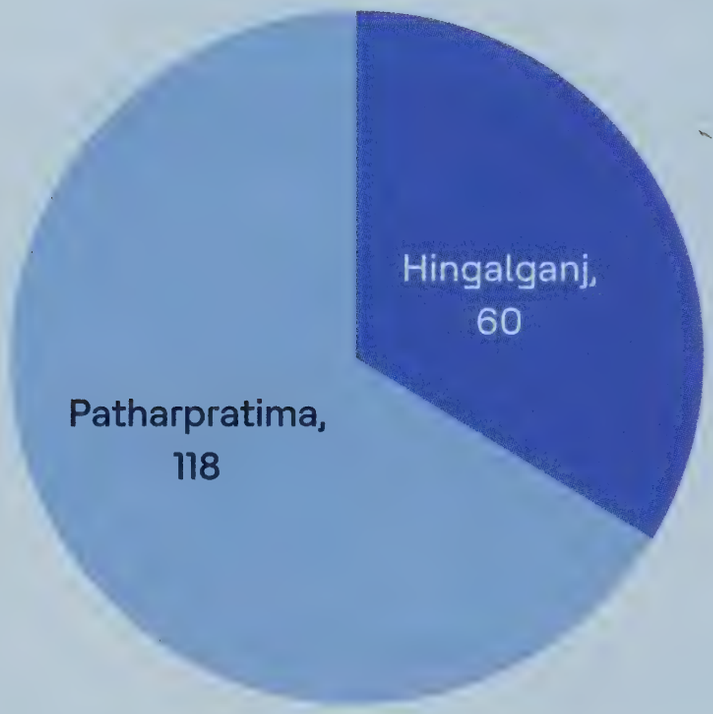
64 species were found in Patharpratima sites such as Lesser whistling duck, Jungle babbler, Red vented bulbul, Common tailorbird, Purple sunbird, White-breasted waterhen, Taiga flycatcher, Small minivet, Greenish warbler, Asian openbill stork, etc. Raptors were also recorded during the survey viz. Brahminy kite, Eurasian marsh harrier, Eurasian sparrowhawk, Oriental honey buzzard and Shikra. Four individuals of Eurasian curlew were also documented a species listed as Near Threatened under IUCN Red List.

Comparatively, the results of Patharpratima mangrove sites were found highly abundant with the bird diversity. However, the Anseriformes (92%), Piciformes (82%), Accipitriformes (78%), Ciconiiformes (72%), Coraciiformes (71%) were found highly dominant orders out of 15 orders followed by others. Similarly, Hingalganj mangrove sites were found highly abundant with Apodiformes (64%), Pelecaniformes (59%), Charadriiformes (52%), Columbiformes (44%), Gruiformes (43%) followed by other orders. Team could not find any species of Cuculiformes, Falconiformes, Psittaciformes, Suliformes orders like cuckoo, kestrel, rose-ringed parakeet etc. during our survey period in Hingalgunj sites.

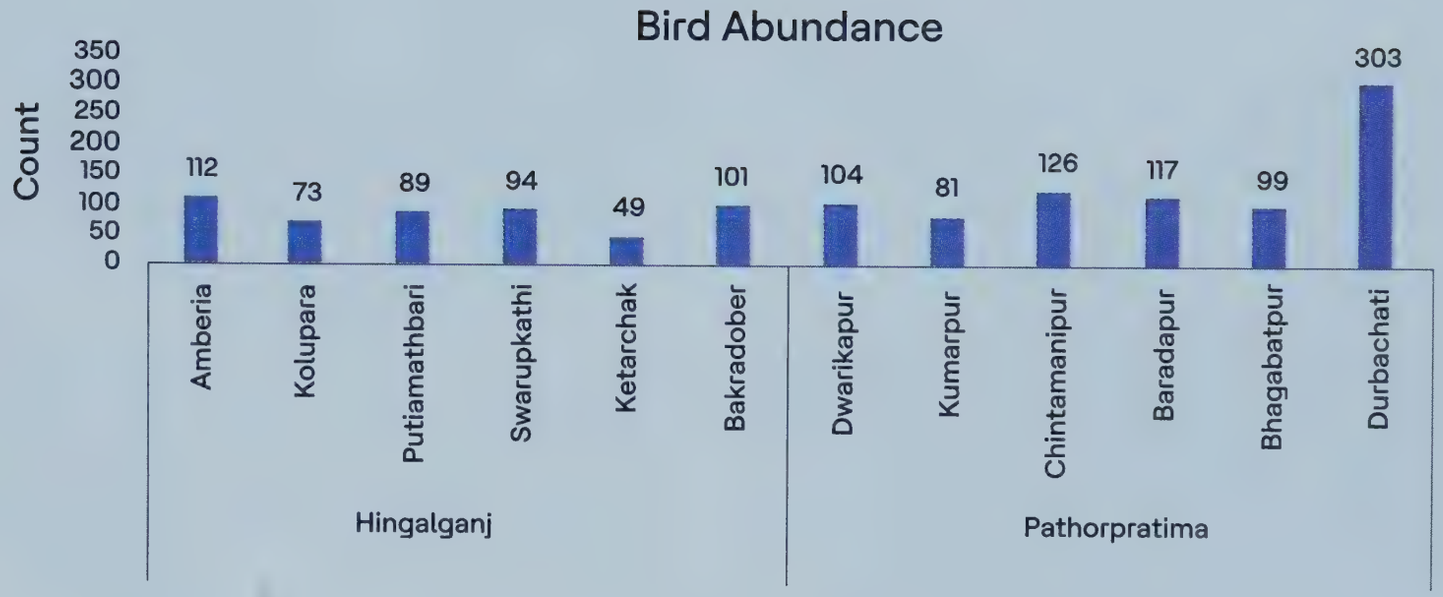


Order wise percentage distribution of birds at both the blocks

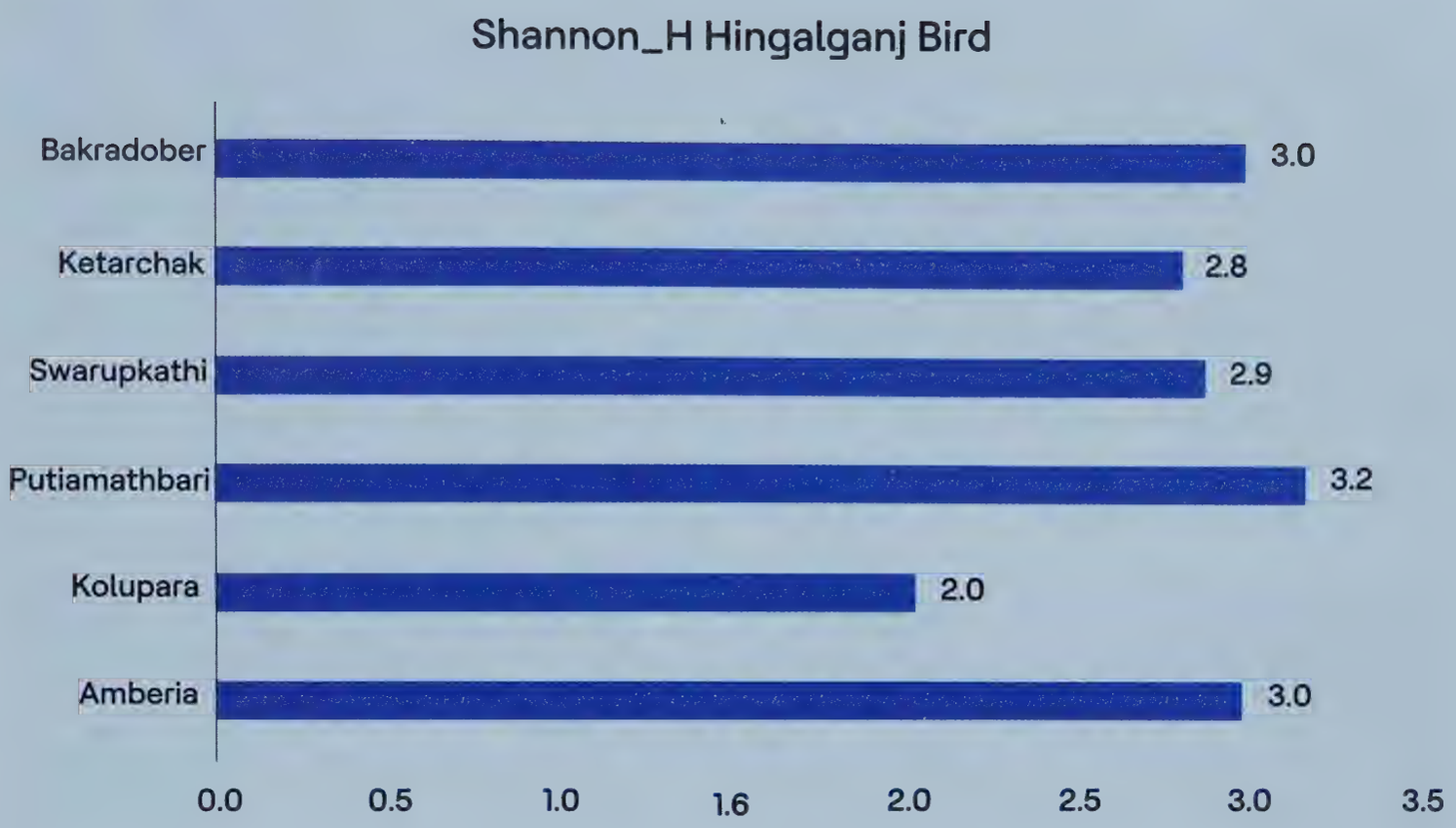
Among all the birds, lesser whistling ducks were the most abundant species because of their social flock gathering at the Durbachati site. Spotted dove was the most common species found across all the sites (40.62 %) followed by Common tailorbird, Asian palm swift, White breasted kingfisher, Purple sunbird, Green bee eater, Common sandpiper, Red vented bulbul, Pond heron, Taiga flycatcher, Common myna (present in more than 20% of study points).



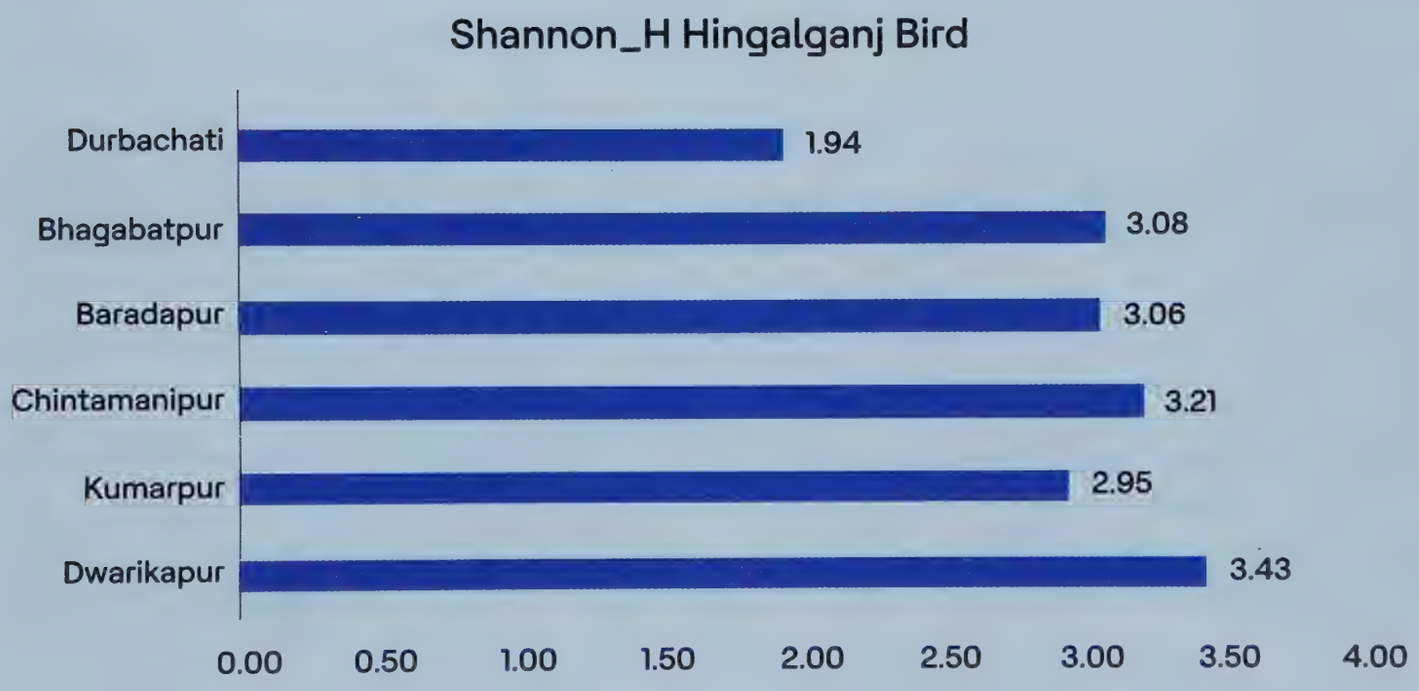
Total bird abundance



Village-wise bird count in both the blocks



Shannon Diversity Index representing diversity of species in all sites of Hingalganj



Shannon Diversity Index representing diversity of species in all sites of Patharpratima

(=< 1.5 richness and abundance is low. In our findings it is more than 1.5 thus shows healthy richness and abundance)

In total, Patharpratima had higher number of bird abundance than Hingalganj (Fig. 1). Bird abundance was highest in Durbachati field site (Fig. 2) Durbachati site has a large waterbody adjacent to it. We found about 190 lesser whistling duck in the site.

Durchati site also had the most number of unique bird species (Fig.3) and Kolupara had the least number of species present. On the other hand, Dwarikapur site has the largest Shannon diversity index value (Fig. 4) and Durbachati site has the lowest Shannon diversity index value. Other types of diversity indices of birds are given in Table 2a, 2b.

Diversity indices	Amberia	Kolupara	Putiamathbari	Swarupkathi	Ketarchak	Bakra dober
Taxa_S	31	17	30	25	22	32
Individuals	112	73	89	94	49	101
Dominance_D	0.08	0.25	0.05	0.08	0.08	0.09
Shannon_H	3.0	2.0	3.2	2.9	2.8	3.0
Menhinick	2.9	2.0	3.2	2.6	3.1	3.2
Chao-1	37.4	19.1	31.9	27.1	31.2	37.5

Table 2a: Diversity indices of birds of Hingalganj field sites.

Diversity indices	Dwarikapur	Kumarpur	Chintamanipur	Baradapur	Bhagabatpur	Durbachati
Taxa_S	40	28	34	36	30	42
Individuals	104	81	126	117	99	303
Dominance_D	0.041	0.074	0.052	0.070	0.060	0.399
Shannon_H	3.43	2.95	3.21	3.06	3.08	1.94
Menhinick	3.92	3.11	3.03	3.33	3.02	2.41
Chao-1	48.1	39.0	40.4	67.7	35.6	57.1

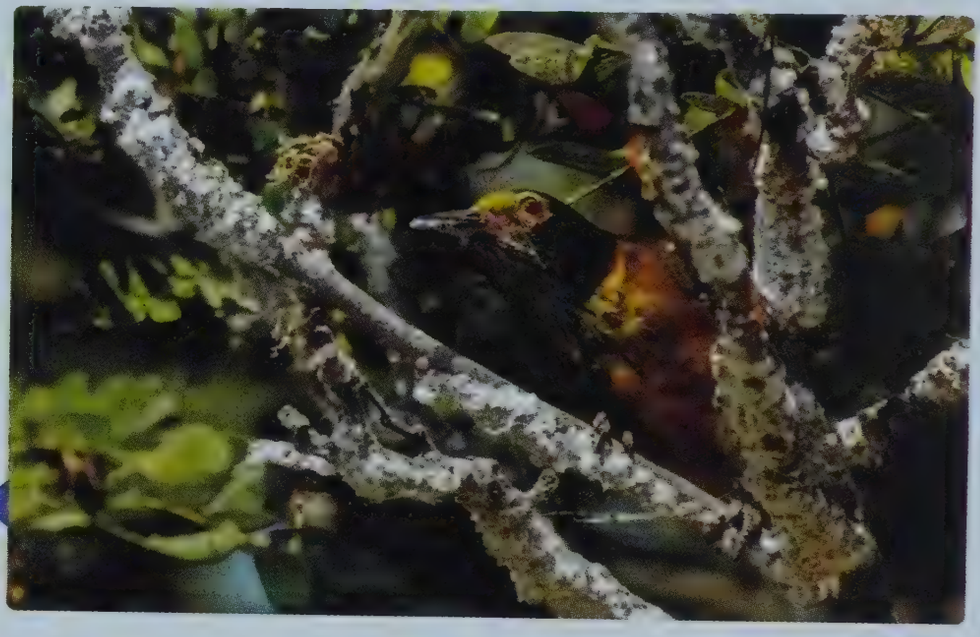
Table 2b: Diversity indices of birds of Patharpratima field sites.

Asian openbill stork
Anastomus oscitans

Black crowned night heron
Nycticorax nycticorax

Black drongo
Dicrurus macrocercus

Black headed cuckooshrike
Lalage melanoptera



Black headed oriole
Oriolus xanthornus

Blue throated barbet
Psilopogon asiaticus

Bronzed drongo
Dicrurus aeneus

Brown shrike
Lanius cristatus

Cinereous tit
Parus cinereus

Collared kingfisher
Todiramphus chloris

Common Iora
Aegithina tiphia

Common kingfisher
Alcedo atthis

Common redshank
Tringa totanus

Common sandpiper
Actitis hypoleucos

Common tailorbird
Orthotomus sutorius

Dusky warbler
Phylloscopus fuscatus

Eurasian sparrowhawk
Accipiter nisus

Gadwall
Mareca strepera

Great egret
Ardea alba

Greater coucal
Centropus sinensis

Green bee eater
Merops orientalis

Green sandpiper
Tringa ochropus

Greenish warbler
Phylloscopus trochiloides

Lesser flameback
Dinopium benghalense

Lesser whistling duck
Dendrocygna javanica

Long Tailed shrike
Lanius schach

Oriental magpie robin
Copsychus saularis

Pacific golden plover
Pluvialis fulva

Pied kingfisher
Ceryle rudis

Plain prinia
Prinia inornata

Pond heron
Ardeola grayii

Purple rumped sunbird
Leptocoma zeylonica

Purple sunbird
Cinnyris asiaticus

Purple swamphen
Porlphyrio porphyrio

Scaly breasted munia
Lonchura punctulata

Shikra
Accipiter badius

Small minivet
Pericrocotus cinnamomeus

Eastern spotted dove
Spilopelia chinensis

Taiga flycatcher
Ficedula albicilla

Whimbrel
Numenius phaeopus

White breasted waterhen
Amauronis phoenicurus

White browed wagtail
Motacilla maderaspatensis

White throated fantail
Rhipidura albicollis

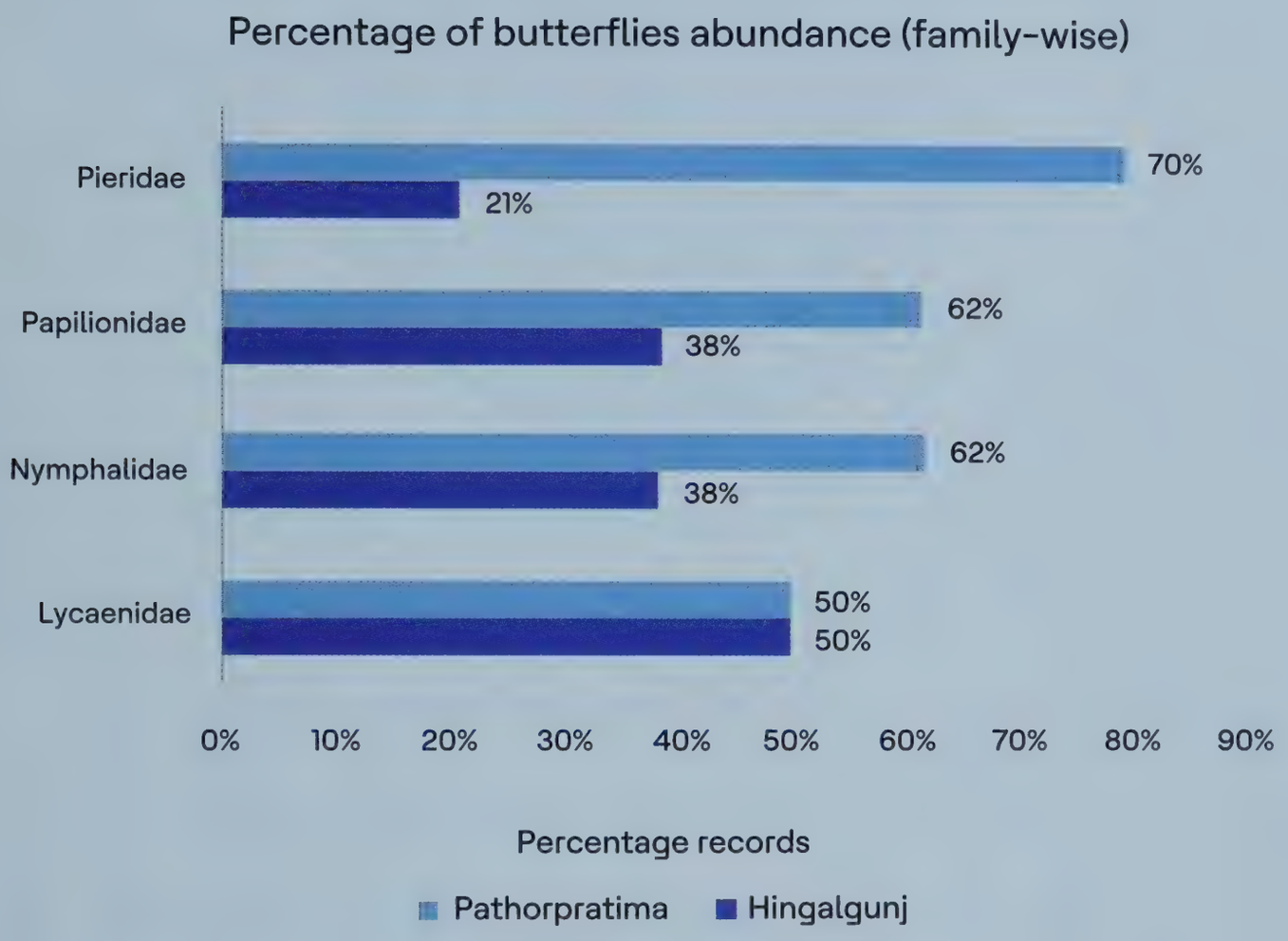
White breasted kingfisher
Halcyon smyrnensis

Butterflies
Honeybees

2. Butterflies

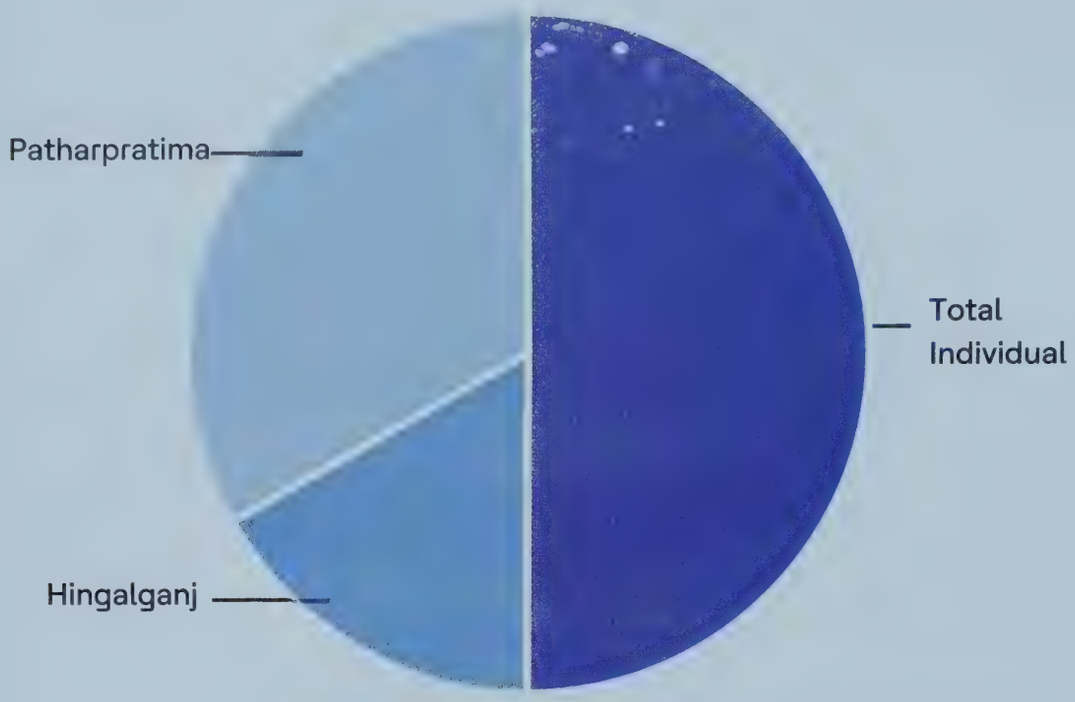
A total of 178 butterflies belonging to 26 species and four families were recorded from both the blocks.(Table 2). Out of all records, 24 species were recorded from Patharpratima and 22 species from Hingalganj Mangrove sites viz. Grey pansy, Peacock pansy, Plain tiger, Common mormon, Common jezebel, etc.

Patharpratima mangrove sites were highly abundant with Pieridae (79%), Papilonidae (62%), Nymphalidae (62%) and Lycaenidae (50%) while comparing with Hingalganj mangrove sites (fig.).

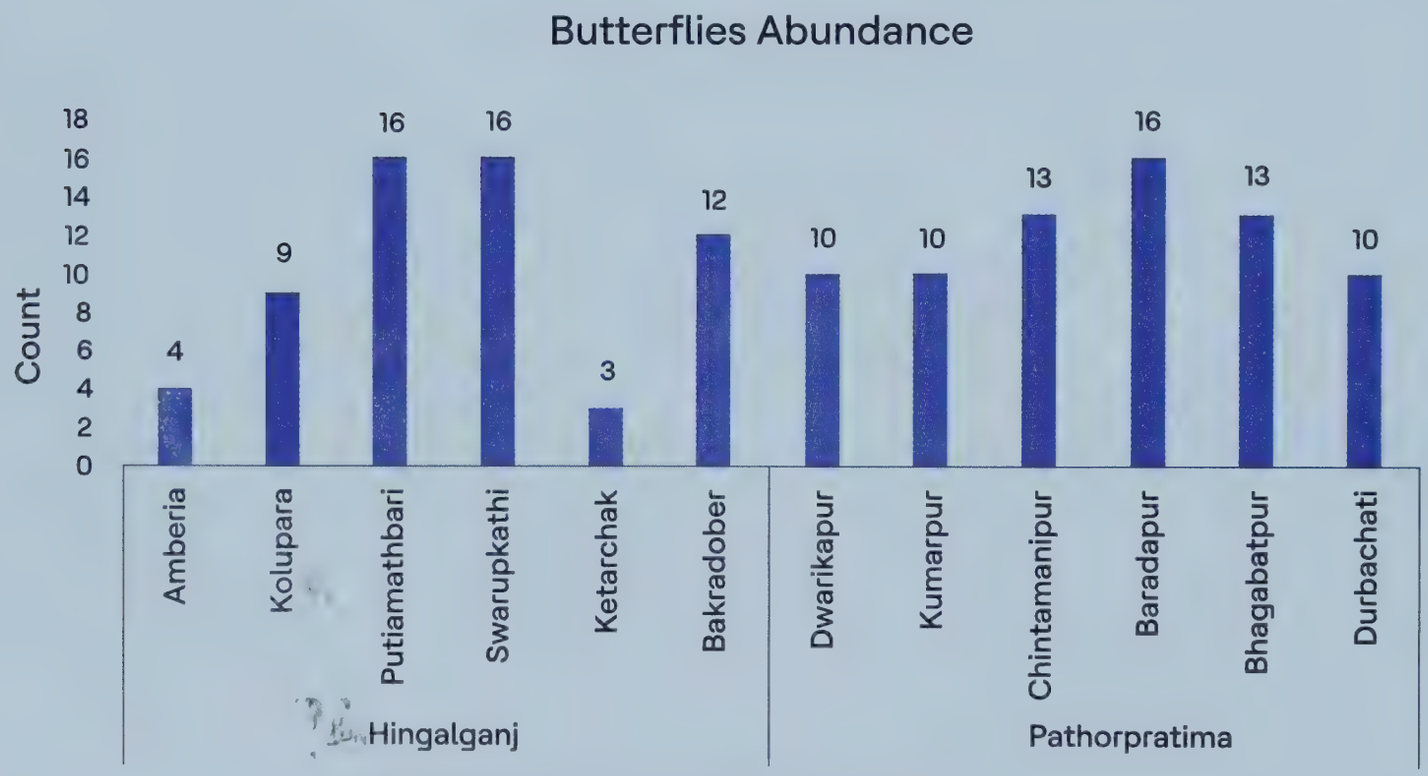


Percentage wise family representation of butterflies

Common jezebel was the most common butterfly species found in the Inventory sites followed by Peacock pansy, Grey pansy, Common Mormon, Grass yellow, Plain tiger, Striped tiger, White tiger, Blue tiger, Mottled emigrant, Chestnut streaked sailor, Lime butterfly (found in more 5 % of all the transects). White tiger is one of the interesting findings because it is not commonly found in other parts of west Bengal.



Total butterflies abundance between Hingalganj (60) and Patharpratima (118).



Individual records of butterflies from both the blocks

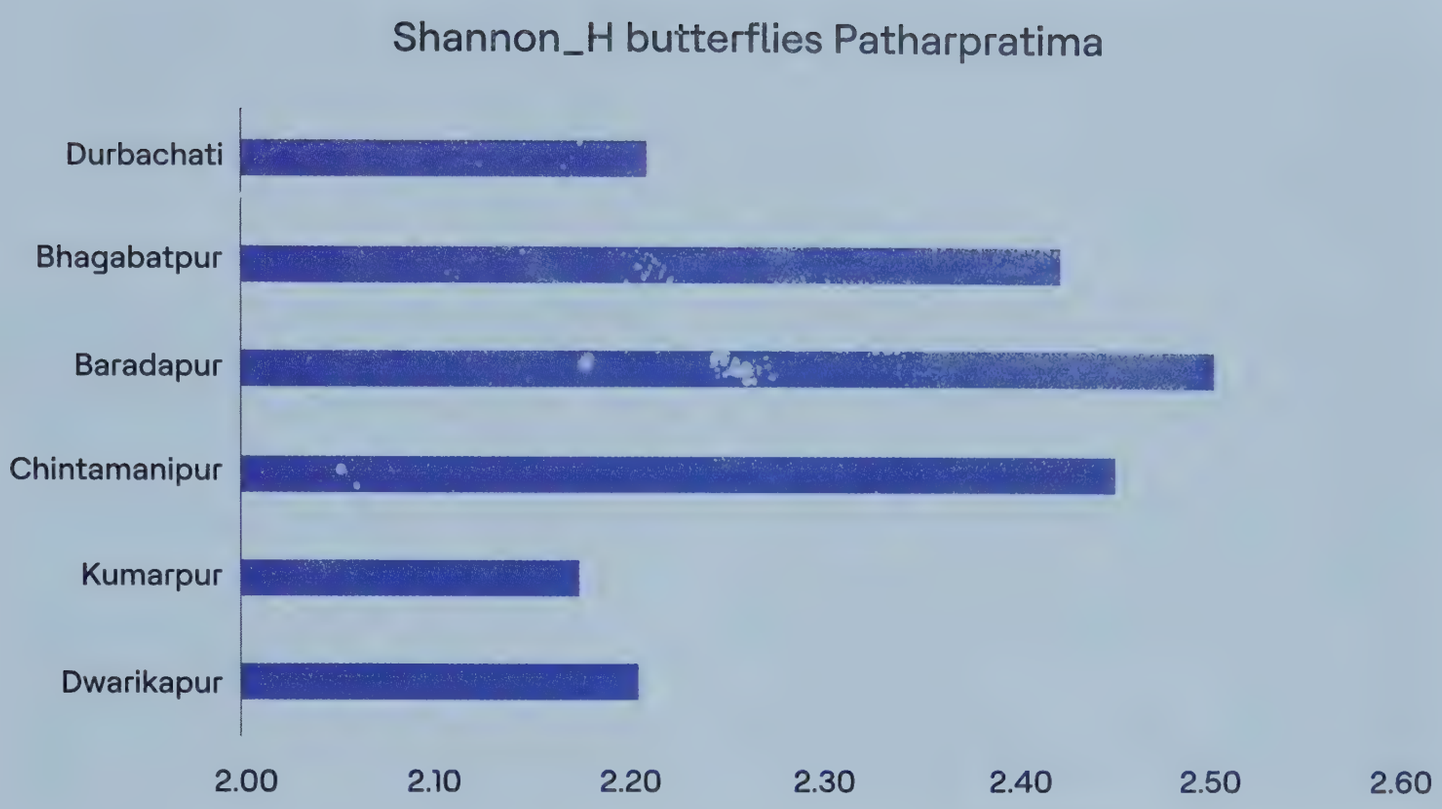


Fig. 7: Representation of butterflies species richness across Patharpratima sites.

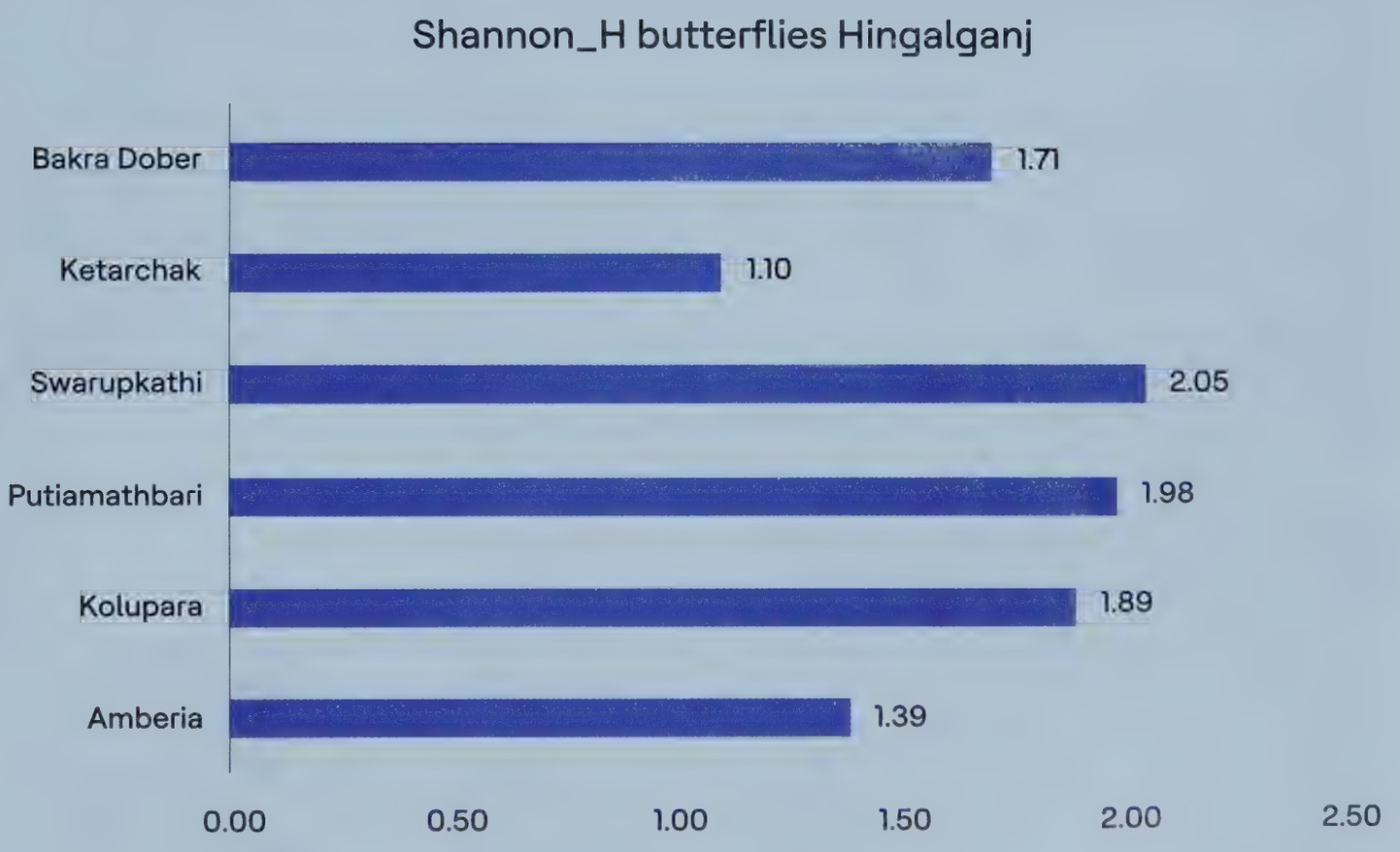


Fig. 8: Representation of butterflies species richness across Hingalganj sites.

Overall, Patharpratima had a higher number of butterfly abundance than Hingalganj (Fig. 5). Butterflies abundance was highest in Baradapur site (Fig. 6) and lowest in Ketarchak. Both butterfly species richness and Shannon diversity value was highest in Baradapur site and lowest in Ketarchak (Fig. 7, Fig. 8). Other types of diversity indices for butterflies are given in table 4a, 4b.

Diversity indices	Amberia	Kolupara	Putiamathbari	Swarupkathi	Ketarchak	Bakra Dober
Taxa_S	4	7	8	9	3	6
Individuals	4	9	16	16	3	12
Dominance_D	0.25	0.16	0.15	0.15	0.33	0.19
Shannon_H	1.39	1.89	1.98	2.05	1.10	1.71
Menhinick	2.00	2.33	2.00	2.25	1.73	1.73
Chao-1	10.00	10.33	9.00	12.33	6.00	6.33

Table 4a: Diversity indices of butterflies of Hingalganj field sites.

Diversity indices indices	Dwarikapur	Kumarpur	Chintamanipur	Baradapur	Bhagabatpur	Durbachati
Taxa_S	10	10	13	16	13	10
Individuals	14	15	22	33	19	15
Dominance_D	0.12	0.13	0.10	0.11	0.10	0.12
Shannon_H	2.21	2.18	2.45	2.50	2.42	2.21
Menhinick	2.67	2.58	2.77	2.79	2.98	2.58
Chao-1	17.00	20.50	18.25	23.20	58.00	13.75

Table 4b: Diversity indices of butterflies of Pathorpratima field sites.

3. Honeybees

2 species of honeybees were found in both the Inventory areas. *Apis cerana. Apis dorsata.* Other than honeybees, 6 species of solitary bees were also found which are as follows: *Xylocopa sp., Lasioglossum sp., Halictus sp., Megachil sp. Nomia sp. Amegilla sp.*

Honeybees and solitary bees are very important species as they are essential ecosystem service providers. They help pollinate crops which benefits us. Restoring mangroves will help in their conservation as it will act as habitat and foraging patch.

Black rajah
Charaxes solon

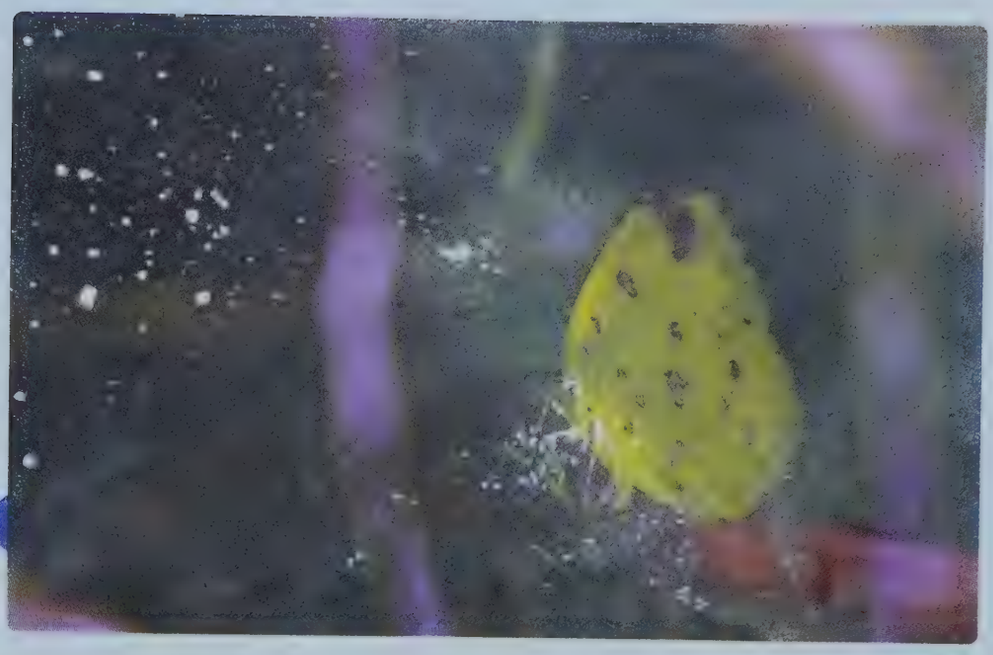
Blue tiger
Tirumala limniace

Chestnut streaked sailor
Neptis jumbah

Common crow
Euploea core

Mottled emigrant
Catopsilia pyranthe

Common evening brown
Melanitis leda



Grass yellow
Eurema hecabe

White tiger
Danaus melanippus

Grey pansy
Junonia atlites

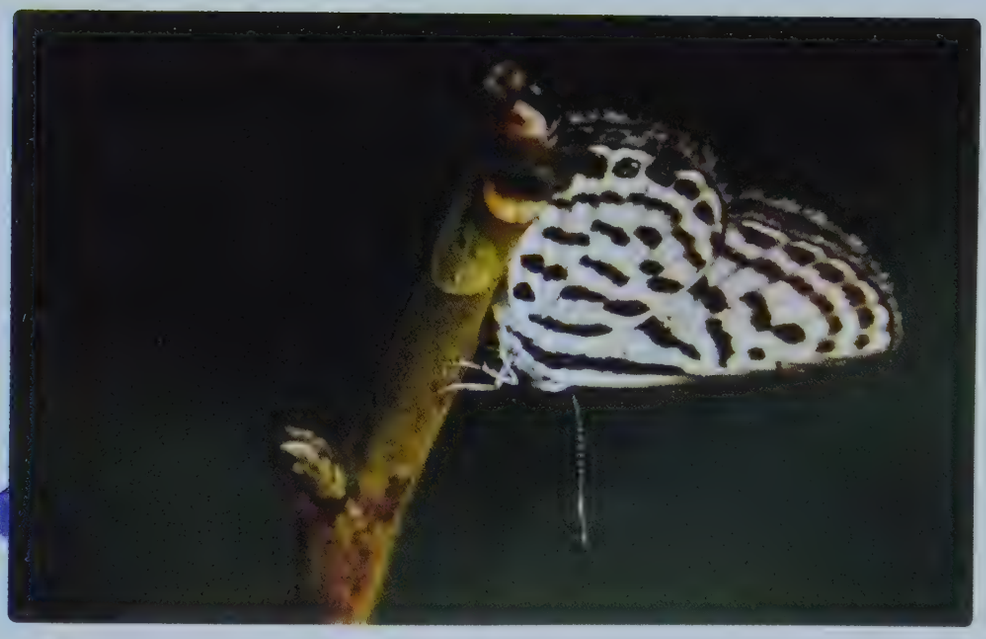
Indian sunbeam
Curetis thetis

Lime butterfly
Papilio demoleus

Peacock pansy
Junonia almana

Palmfly
Elymnias hypermnestra

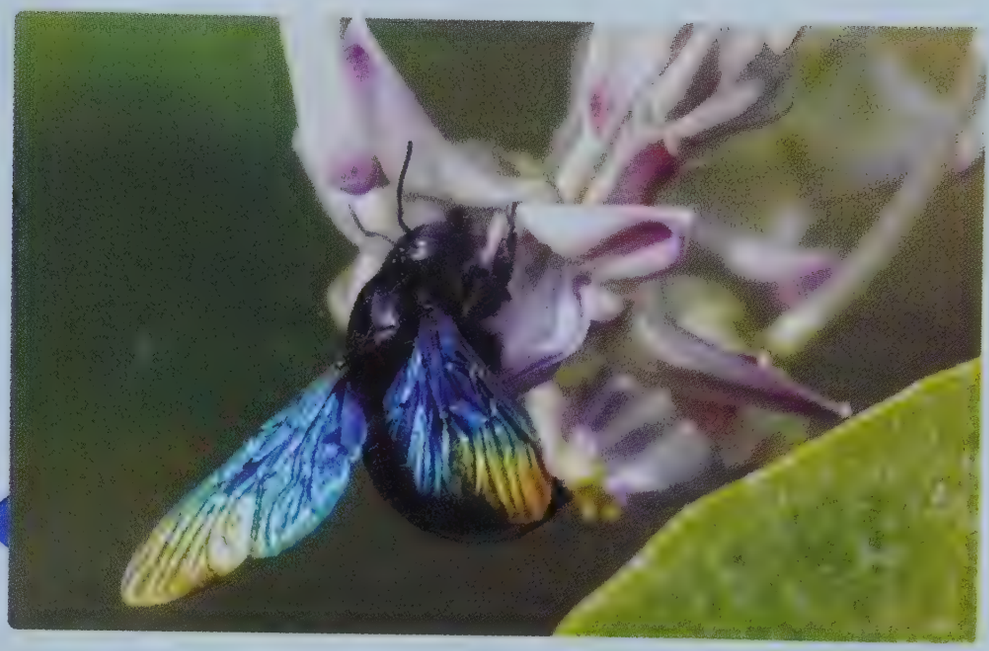
Plain tiger
Danaus chrysippus



Spotted pierrot
Tarucus callinara

Striped tiger
Danaus genutia

Tawny coaster
Acraea terpsicore



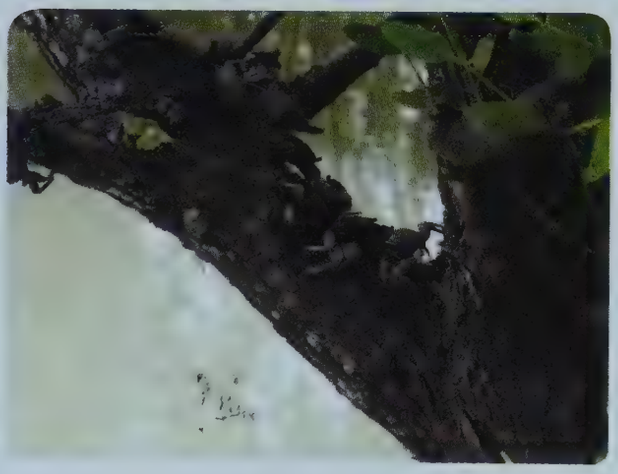
Carpenter bee
Xylocopa sp1.

Apiscerana

Xylocopa sp2

Marine Fauna - the next step

"The Sundarbans is rich with marinel fauna like several crabs, mudskippers, molluscs, reptiles, and other associated species. At the beginning, the team occasionally and opportunistically has documented a couple of crab, mudskipper species. Based on the existing exercise, team is expanding to explore and document more on marine fauna in next phase of biodiversity inventory, it would be followed by science based techniques."



Key Take Away

Biodiversity Inventory: The Inventory focused on three important taxa - birds, butterflies, and bees - to assess the overall biodiversity of ongoing mangrove restoration sites. By examining multiple taxonomic groups, researchers can gain a more comprehensive understanding of ecosystem health and functioning. Each of these groups plays a vital role in ecosystem dynamics, such as pollination (in the case of bees and butterflies) and trophic interactions (in the case of birds). Mangrove ecosystems are critical coastal habitats that provide numerous ecological and socio-economic benefits, including shoreline protection, carbon sequestration, and support for diverse wildlife. However, mangrove forests worldwide have been subject to degradation and loss due to human activities such as deforestation, aquaculture, and urbanization. Mangrove restoration initiatives aim to reverse these trends by replanting mangrove species and restoring degraded habitats. The observed differences between the Hinganganj and Patharpratima sites highlight the variability in restoration outcomes within mangrove ecosystems. Factors such as mangrove patch type, age, and connectivity can influence habitat quality and, consequently, biodiversity. Patharpratima sites exhibited higher species abundance and richness, likely due to the presence of mature mangrove vegetation and connectivity with larger, older mangrove forests. Understanding these differences is essential for tailoring restoration strategies to specific site conditions and maximizing biodiversity benefits. The Inventory underscores and the importance of habitat quality in shaping biodiversity patterns within mangrove ecosystems. Habitat structure, vegetation composition, hydrology, and disturbance regimes are among the key factors influencing biodiversity at both patch and landscape scales. By elucidating the relationship between habitat quality and biodiversity, researchers can identify priority areas for conservation and restoration efforts. The findings of the Inventory have important implications for conservation and management of mangrove ecosystems. By prioritizing the restoration of well-connected and mature mangrove patches, conservationists can enhance habitat quality and promote biodiversity conservation. Furthermore, understanding the factors driving biodiversity patterns can inform adaptive management strategies, helping to address emerging threats such as climate change and habitat fragmentation. The study highlights the need for further research to deepen our understanding of mangrove ecosystem dynamics and the factors influencing biodiversity. Long-term monitoring programs, coupled with experimental studies and landscape-scale assessments, can provide valuable insights into the effectiveness of restoration interventions and the resilience of mangrove ecosystems to environmental change.

In summary, the Inventory contributes to our knowledge of biodiversity patterns in mangrove restoration sites and underscores the importance of considering habitat quality and connectivity in conservation and management strategies. By integrating ecological research with practical conservation efforts, we can work towards safeguarding these invaluable coastal ecosystems for future generations.

Add more about community engagement and citizen science approach, PBR Process and importance of such biodiversity inventories and also for collecting technical data using traditional knowledge.

ANNEXURES

Checklist of birds (Table 1)

Table 1: HNG = abundance in Hingalganj, PTH= abundance in Patharpratima.

Order	Family	Common name	Scientific name	IUCN status	HNG	PTH
Accipitriformes	Accipitridae	Brahminy kite	*Haliastur indus*	LC	0	2
Accipitriformes	Accipitridae	Eurasian marsh harrier	*Circus aeruginosus*	*LC*	*0*	*1*
Accipitriformes	Accipitridae	Eurasian sparrowhawk	*Accipiter nisus*	LC	0	1
Accipitriformes	Accipitridae	Oriental honey buzzard	*Pernis ptilorhynchus*	LC	0	1
Accipitriformes	Accipitridae	Shikra	*Accipiter badius*	LC	2	2
Anseriformes	Anatidae	Gadwall	*Mareca strepera*	LC	17	0
Anseriformes	Anatidae	Lesser whistling duck	*Dendrocygna javanica*	LC	0	190
Apodiformes	Apodidae	Asian palm swift	*Cypsiurus balasiensis*	lc	93	52
Charadriiformes	Jacanidae	Bronze winged jacana	*Metopidius indicus*	LC	0	4
Charadriiformes	Scolopacidae	Common red shank	*Tringa totanus*	LC	3	2
Charadriiformes	Scolopacidae	Common sand piper	*Actitis hypoleucos*	LC	17	12
Charadriiformes	Scolopacidae	Eurasian Curlew	*Numenius arquata*	NT	2	2
Charadriiformes	Scolopacidae	Green sandpiper	*Tringa ochropus*	LC	6	0
Charadriiformes	Charadriidae	Pacific golden plover	*Pluvialis fulva*	LC	6	0
Charadriiformes	Charadriidae	Red wattled lapwing	*Vanellus indicus*	LC	0	7
Charadriiformes	Scolopacidae	Terek sandpiper	*Xenus cinereus*	LC	6	0
Charadriiformes	Scolopacidae	Whimbrel	*Numenius phaeopus*	LC	3	12
Ciconiiformes	Ciconiidae	Asian openbill stork	*Anastomus oscitans*	LC	5	13
Columbiformes	Columbidae	Eurasian collared dove	*Streptopelia decaocto*	LC	5	9
Columbiformes	Columbidae	Spotted dove	*Spilopelia chinensis*	LC	32	38
Coraciiformes	Alcedinidae	Collared kingfisher	*Todiramphus chloris*	LC	9	4
Coraciiformes	Alcedinidae	Common kingfisher	*Alcedo atthis*	LC	7	11
Coraciiformes	Meropidae	Green bee eater	*Merops orientalis*	LC	14	47
Coraciiformes	Alcedinidae	Pied kingfisher	*Ceryle rudis*	LC	0	6
Coraciiformes	Alcedinidae	White throated kingfisher	*Halcyon smyrnensis*	LC	0	6
Cuculiformes	Cuculidae	Asian koel	*Eudynamys scolopaceus*	LC	0	2
Cuculiformes	Cuculidae	Common hawk cuckoo	*Hierococcyx varius*	LC	0	2
Cuculiformes	Cuculidae	Eurasian cuckoo	*Cuculus canorus*	LC	0	1
Cuculiformes	Cuculidae	Greater coucal	*Centropus sinensis*	LC	0	3
Falconiformes	Falconidae	Common kestrel	*Falco tinnunculus*	LC	0	1

Order	Family	Common name	Scientific name	IUCN status	HNG	PTH
Gruiformes	Rallidae	Common moorhen	*Gallinula chloropus*	LC	3	0
Gruiformes	Rallidae	Purple swamphen	*Porphyrio porphyrio*	LC	2	0
Gruiformes	Rallidae	White breasted waterhen	*Amauronis phoenicurus*	LC	11	21
Passeriformes	Artamidae	Ashy wood swallow	*Artamus fucus*	LC	2	0
Passeriformes	Hirundinidae	Barn swallow	*Hirundo rustica*	LC	2	0
Passeriformes	Dicruridae	Black drongo	*Dicrurus macrocercus*	LC	14	7
Passeriformes	Campephagidae	Black headed cuckooshrike	*Lalage melanoptera*	LC	1	0
Passeriformes	Oriolidae	Black headed oriole	*Oriolus xanthornus*	LC	5	5
Passeriformes	Muscicapidae	Bluethroat	*Luscinia svecica*	LC	1	0
Passeriformes	Acrocephalidae	Blyth's reed warbler	*Acrocephalus dumetorum*	LC	3	8
Passeriformes	Dicruridae	Bronzed drongo	*Dicrurus aeneus*	LC	6	6
Passeriformes	Laniidae	Brown shrike	*Lanius cristatus*	LC	4	1
Passeriformes	Paridae	Cinereous tit	*Parus cinereus*	LC	1	0
Passeriformes	Motacillidae	Citrine wagtail	*Motacilla citreola*	LC	1	1
Passeriformes	Acrocephalidae	Clamorous reed warbler	*Acrocephalus stentoreus*	LC	4	6
Passeriformes	Phylloscopidae	Common chiffchaff	*Phylloscopus collybita*	LC	0	2
Passeriformes	Aegithinidae	Common iora	*Aegithina tiphia*	LC	12	4
Passeriformes	Sturnidae	Common myna	*Acridotheres tristis*	LC	22	23
Passeriformes	Cisticolidae	Common tailorbird	*Orthotomus sutorius*	LC	11	29
Passeriformes	Phylloscopidae	Dusky warbler	*Phylloscopus fuscatus*	LC	3	4
Passeriformes	Phylloscopidae	Greenish warbler	*Phylloscopus trochiloides*	LC	3	15
Passeriformes	Passeridae	House sparrow	*Passer domesticus*	LC	29	10
Passeriformes	Leiothrichidae	Jungle babbler	*Argya striata*	LC	10	39
Passeriformes	Corvidae	Jungle crow	*Corvus macrorhynchos*	LC	13	21
Passeriformes	Muscicapidae	Oriental magpie robin	*Copsychus saularis*	LC	10	8
Passeriformes	Sturnidae	Pied starling	*Gracupica contra*	LC	10	2
Passeriformes	Cisticolidae	Plain prinia	*Prinia inornata*	LC	15	12
Passeriformes	Nectariniidae	Purple rumped sunbird	*Leptocoma zeylonica*	LC	12	21
Passeriformes	Nectariniidae	Purple sunbird	*Cinnyris asiaticus*	LC	19	26
Passeriformes	Pycnonotidae	Red vented bulbul	*Pycnonotus cafer*	LC	9	35
Passeriformes	Corvidae	Rufous treepie	*Dendrocitta vagabunda*	LC	1	6
Passeriformes	Estrildidae	Scaly-breasted Munia	*Lonchura punctulata*	LC	8	10
Passeriformes	Campephagidae	Small minivet	*Pericrocotus cinnamomeus*	LC	5	16
Passeriformes	Muscicapidae	Taiga flycatcher	*Ficedula albicilla*	LC	5	17
Passeriformes	Pycnonotidae	Whiskered bulbul	*Pycnonotus jocosus*	LC	0	3
Passeriformes	Motacillidae	White browed wagtail	*Motacilla maderaspatensis*	LC	2	2
Passeriformes	Rhipiduridae	White throated fantail	*Rhipidura albicollis*	LC	1	0

Order	Family	Common name	Scientific name	IUCN status	HNG	PTH
Passeriformes	Motacillidae	White wagtail	*Motacilla alba*	LC	2	1
Passeriformes	Cisticolidae	Zitting cisticola	*Cisticola juncidis*	LC	4	0
Pelecaniformes	Ardeidae	Black bittern	*Ixobrychus flavicollis*	LC	0	1
Pelecaniformes	Ardeidae	Black-crowned night heron	*Nycticorax nycticorax*	LC	0	2
Pelecaniformes	Ardeidae	Great egret	*Ardea alba*	LC	6	5
Pelecaniformes	Ardeidae	Grey heron	*Ardea cinerea*	LC	1	0
Pelecaniformes	Ardeidae	intermediate egret	*Ardea intermedia*	LC	3	0
Pelecaniformes	Ardeidae	Little egret	*Egretta garzetta*	LC	2	0
Pelecaniformes	Ardeidae	Pond heron	*Ardeola grayii*	LC	12	9
Piciformes	Picidae	Lesser goldenback woodpecker	*Dinopium benghalense*	LC	1	4
Piciformes	Picidae	Rufous woodpecker	*Micropternus brachyurus*	LC	0	1
Psittaciformes	Psittaculidae	Rose ringed parakeet	*Psittacula krameri*	LC	0	6
Suliformes	Phalacrocoracidae	Indian cormorant	*Phalacrocorax fuscicollis*	LC	0	1
Suliformes	Phalacrocoracidae	Little cormorant	*Microcarbo niger*	LC	0	9

Mangroves

Kankra (*Bruguiera gymnorhiza*)
Baine (*Avicennia officinalis*)
Goran (*Ceriops decandra*)
Golpata (*Nypa fruticans*)
Sundari (*Heritiera fomes*)
Garjan (*Rhizophora apiculata*)
Kewra (*Sonneratia apetala*)

Multi Purpose Trees (MPT)

Mango (*Mangifera indica*)
Sirish (*Albizia lebbeck*)
Minjiri (*Senna siamea*)
Tamarind (*Tamarindus indica*)
Neem (*Azadirachta indica*)
Jamun (*Syzygium cumini*)
Jujube (*Ziziphus mauritiana*)
Arjun (*Terminalia arjuna*)
Babla (*Vachellia nilotica*)
Subabul (*Leucaenia leucocephala*)

Checklist of butterflies (Table 3)

Table 3: HNG = abundance in Hingalganj, PTH= abundance in Patharpratima.

Family`	Common name	Scientific name	IUCN status	HNG	PTH
Lycaenidae	Indian sunbeam	*Curetis thetis*	LC	0	1
Lycaenidae	Spotted Pierrot	*Tarucus callinara*	NE	1	0
Nymphalidae	Black Rajah	*Charaxes solon*	NE	0	1
Nymphalidae	Blue tiger	*Tirumala limniace*	NE	3	4
Nymphalidae	Chestnutstreaked sailor	*Neptis jumbah*	NE	2	3
Nymphalidae	Common castor	*Ariadne merione*	NE	0	2
Nymphalidae	Common crow	*Euploea core*	LC	2	2
Nymphalidae	Common crow	*Euploea core*	VU	0	1
Nymphalidae	Common evening brown	*Melanitis leda*	LC	1	1
Nymphalidae	Great eggfly	*Hypolimnas bolina*	NE	0	1
Nymphalidae	Grey pansy	*Junonia atlites*	NE	10	9
Nymphalidae	Palm fly	*Elymnias hypermnestra*	LC	1	6
Nymphalidae	Peacock pansy	*Junonia almana*	LC	10	11
Nymphalidae	Plain tiger	*Danaus chrysippus*	LC	7	4
Nymphalidae	Striped tiger	*Danaus genutia*	LC	2	9
Nymphalidae	Tawny coaster	*Acraea terpsicore*	LC	0	1
Nymphalidae	White tiger	*Danaus melanippus*	LC	1	8
Papilionidae	Common mime	*Papilio clytia*	LC	2	2
Papilionidae	Common mormon	*Papilio polytes*	NE	7	8
Papilionidae	Lime butterfly	*Papilio demoleus*	LC	0	5
Papilionidae	Tailed jay	*Graphium agamemnon*	LC	1	1
Pieridae	Common emigrant	*Catopsilia pyranthe*	NE	1	2
Pieridae	Common jezebel	*Delias eucharis*	LC	7	16
Pieridae	Grass yellow	*Eurema hecabe*	LC	1	13
Pieridae	Mottled emigrant	*Catopsilia pyranthe*	LC	1	5
Pieridae	yellow orange tip	*Ixias pyrene*	LC	0	2

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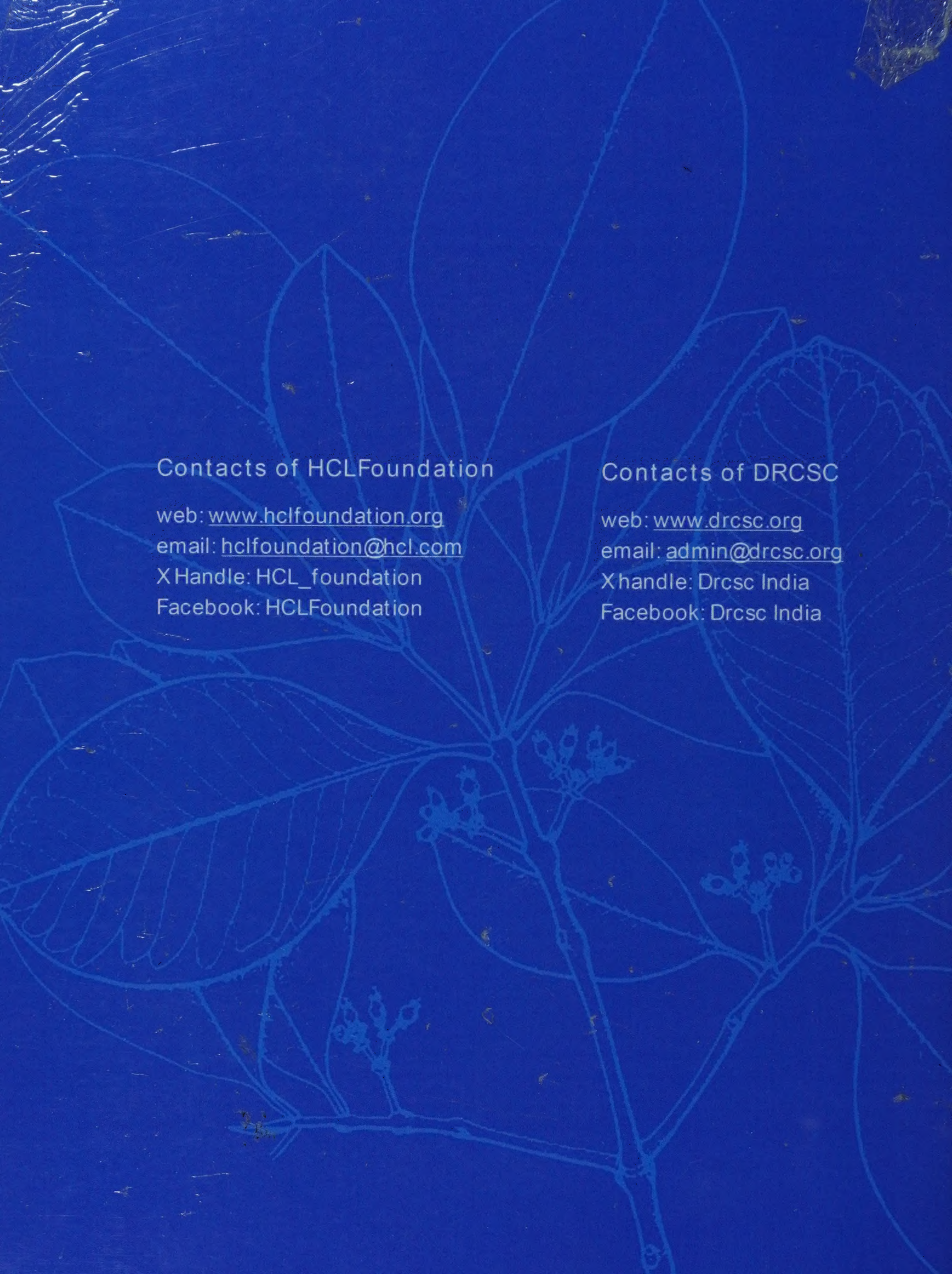

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